AMENDMENTS TO THE CLAIMS

1. (Currently Amended) A method of segmenting a composite image of pixels of a physical document into a number of fields corresponding to lay-out elements of the image of the physical document, the pixels having a value representing the intensity and/or color of a picture element, the method comprising:

analyzing the pixels of the image as either background pixels having a background property indicative of a background of the image or foreground pixels not having said background property;

detecting in the image any foreground separator elements that are objects in the foreground of the image having a pattern of foreground pixels;

replacing the pixels of the detected foreground separators by pixels having the background property;

constructing separating elements corresponding to rectangular areas of adjacent pixels of the image having the background property; and

constructing a graph representing the lay-out elements of the image of the physical document by

- defining vertices of the graph on the basis of intersections of separating elements that are substantially oriented in predetermined separation directions,

- defining edges of the graph between the vertices corresponding to the separating elements, and

- defining field separators corresponding to the edges of the graph.

2. (Original) The method as claimed in claim 1, wherein the step of defining vertices comprises:

constructing subsets of the separating elements that are substantially oriented in the predetermined separation directions, and

determining the intersections between pairs of separating elements from the subsets.

3. (Original) The method as claimed in claim 2, wherein the step of determining the intersections comprises:

determining an area of overlap of the separating elements from the subsets, and

locating the vertex at the center of the area of overlap.

4. (Original) The method as claimed in claim 1, wherein the graph constructing step comprises:

assigning a weight to the edges indicating an Euclidean distance between the vertices.

5. (Original) The method as claimed in claim 1, further comprising:

constructing a set of maximal rectangles, a maximal rectangle being a rectangular part of the image in one of the separation directions, that has the maximum possible area without including a pixel not having the background property indicative of a background of the image; and

constructing the separating elements in a cleaning step wherein at least one pair of overlapping maximal rectangles in the set is replaced by an informative rectangle that is a

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rectangular part of an area combining the areas of the pair, the rectangular part having the

maximum possible length in the relevant separation direction.

6. (Original) The method as claimed in claim 5, wherein the cleaning step further

comprises at least one of the following:

deleting a maximal rectangle having a length below a predefined value,

deleting a maximal rectangle having a width below a predefined value, and

deleting a maximal rectangle having an aspect ratio below a predefined value, the aspect

ratio being a longer side length divided by a shorter side length.

7. (Original) The method as claimed in claim 5, wherein, prior to the step of constructing

the maximal rectangles, the image is preprocessed by at least one of the following:

removing noise by adapting the value of isolated deviant pixels to an average value of

pixels in the neighborhood,

halftoning by transforming the pixels to either white or black, and

reducing the number of pixels by downsampling.

8. (Cancelled)

9. (Previously Presented) The method as claimed in claim 1, wherein the foreground

separator elements include black lines, dashed lines, or dotted lines.

PCL/GH/ma

10. (Original) The method as claimed in claim 5, wherein the step of constructing the maximal rectangles comprises:

determining a list of maximal runs, a maximal run being a straight line of pixels having the background property, the line having the maximum possible length without including a pixel not having the background property,

taking a specific maximal run from the list as rectangle,

testing the rectangle if extension is possible by determining for a next maximal run if the next maximal run comprises pixels adjacent to pixels of the rectangle in a width direction,

if the extension is possible, extending the rectangle by constructing a new rectangle having the maximum area including pixels of the rectangle and the next maximal run,

if no extension is possible, adding the rectangle to the set of maximal rectangles, and

eliminating from the list any maximal run that is completely contained in the new rectangle.

11. (Original) The method as claimed in claim 1, wherein the step of constructing the separating elements comprises:

processing the image in two orthogonal separation directions.

12. (Original) The method as claimed in claim 1, wherein the step of constructing the separating elements comprises:

detecting graphical elements that are objects in the foreground of the image having a pattern of pixel values deviating from said background property, wherein the separating elements are constructed around the graphical elements.

13. (Original) The method as claimed in claim 1, wherein at least one of the fields is classified as text field, a reading order is detected in the text field, and foreground components are joined to text lines in the text field in a direction corresponding to said reading order.

14. (Currently Amended) A computer program product embodied on at least one computer-readable medium, A computer-readable storage medium containing a computer program comprising computer-executable instructions for segmenting an image of pixels into a number of fields, corresponding to lay-out elements of the image, the pixels having a value representing the intensity and/or color of a picture element, the computer program product comprising computer-executable instructions for:

analyzing the pixels of the image as either background pixels having a background property indicative of a background of the image or foreground pixels not having said background property;

detecting in the image any foreground separator elements that are objects in the foreground of the image having a pattern of foreground pixels;

replacing the pixels of the detected foreground separator elements by pixels having the background property;

constructing separating elements corresponding to rectangular areas of adjacent pixels of

the image having the background property; and

constructing a graph representing the lay-out elements of the image by

- defining vertices of the graph on the basis of intersections of separating elements

that are substantially oriented in predetermined separation directions,

- defining edges of the graph between the vertices corresponding to the separating

elements, and

- defining field separators corresponding to the edges of the graph.

15. (Currently Amended) The computer-readable storage mediumcomputer program

product as claimed in claim 14, wherein the computer-executable instructions for defining

vertices comprise computer-executable instructions for:

constructing subsets of the separating elements that are substantially oriented in the

predetermined separation directions, and

determining the intersections between pairs of separating elements from the subsets.

16. (Currently Amended) The computer-readable storage mediumcomputer program

product as claimed in claim 14, wherein at least one of the fields is classified as text field, a

reading order is detected in the text field, and foreground components are joined to text lines in

the text field in a direction corresponding to said reading order.

PCL/GH/ma

17. (Currently Amended) The computer-readable storage medium computer program product as claimed in claim 14, further comprising computer-executable instructions for:

constructing a set of maximal rectangles, a maximal rectangle being a rectangular part of the image in one of the separation directions, that has the maximum possible area without including a pixel not having the background property indicative of a background of the image; and

constructing the separating elements in a cleaning step wherein at least one pair of overlapping maximal rectangles in the set is replaced by an informative rectangle that is a rectangular part of an area combining the areas of the pair, the rectangular part having the maximum possible length in the relevant separation direction.

18. (Previously Presented) A device for segmenting a composite image of pixels into a number of fields corresponding to lay-out elements of the image, the pixels having a value representing the intensity and/or color of a picture element, the device comprising:

an input unit for inputting an image; and

a processing unit for analyzing the pixels of the image as either background pixels having a background property indicative of a background of the image or foreground pixels not having said background property; detecting in the image any foreground separator elements that are objects in the foreground of the image having a pattern of foreground pixels; replacing the pixels of the detected foreground separators by pixels having the background property; and constructing a graph representing the lay-out elements of the image by

- constructing separating elements corresponding to rectangular areas of adjacent

pixels of the image having the background property,

- defining vertices of the graph based on intersections of separating elements that

are substantially oriented in different separation directions, and

- defining edges of the graph between the vertices corresponding to the separating

elements.

19. (Original) The device as claimed in claim 18, further comprising:

a display unit for displaying fields of the image after segmenting.

20. (Original) The device as claimed in claim 18, wherein the processing unit constructs a

set of maximal rectangles, a maximal rectangle being a rectangular part of the image in one of

the separation directions, that has the maximum possible area without including a pixel not

having the background property indicative of a background of the image; and constructs the

separating elements in a cleaning step wherein at least one pair of overlapping maximal

rectangles in the set is replaced by an informative rectangle that is a rectangular part of an area

combining the areas of the pair, the rectangular part having the maximum possible length in the

relevant separation direction.

21. (Original) The device as claimed in claim 18, wherein at least one of the fields is

classified as text field, a reading order is detected in the text field, and foreground components

are joined to text lines in the text field in a direction corresponding to said reading order.

22. (Previously Presented) The method as claimed in claim 1, wherein the rectangular areas are white areas.

23. (Currently Amended) The computer-readable storage mediumcomputer program product as claimed in claim 14, wherein the rectangular areas are white areas.

24. (Previously Presented) The device as claimed in claim 18, wherein the rectangular areas are white areas.

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